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Variability in ISOW Vigor Over the Last two Millennia and its Relationship to Climate

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Low frequency variability in the Atlantic Meridional Overturning Circulation (AMOC) constitutes a key uncertainty in predictions of future climate, ocean, and atmospheric CO_2 changes. Although AMOC variability is commonly invoked to explain low frequency climate variability observed on millennial to multidecadal timescales during the Holocene, there is very little observational or paleoclimatic evidence available to test these hypotheses. In short, empirical constraints on the nature and magnitude of ocean variability (under a range of boundary conditions) are sorely needed before we can hope to evaluate and understand the role of the ocean in either past or future climate changes.

Here we use well dated (^{210}Pb and AMS ^{14}C), high sedimentation rate, multi and gravity cores taken on the Gardar Sediment Drift (60˚19'N, 23˚58'W, 2081 m water depth) to reconstruct decadal to centennial variability in the properties and vigor of the eastern branch of the Nordic Seas overflows over the past two millennia. The Gardar drift accumulates on the eastern flank of the Reykjanes Ridge due to the supply of sediments provided by the overlying Iceland Scotland Overflow Water (ISOW)—an important constituent of North Atlantic Deep Water (NADW). We reconstruct the bottom water physical and chemical properties of ISOW using the oxygen and carbon isotopes of benthic foraminifera (*C. wuellerstorfi*), while changes in the vigor of near bottom flow are inferred from size variations in the sediment proxy mean sortable silt. In addition, changes in surface hydrography are reconstructed using the δ^{18}O of several planktonic foraminifer species *G. bulloides, G. inflata*, and *N. pachyderma* (d).

Our records provide a sub-decadally sampled history of ISOW variability spanning the last ∼2000 years. Our results reveal that AMOC variability is tightly coupled to low frequency variations in basin-wide climate (Atlantic Multidecadal Oscillation-AMO). In particular, that the eastern branch of the Nordic Seas overflows (ISOW) covaried with AMO over the past ∼350 years on both inter-decadal and centennial timescales, with increased (decreased) ISOW vigor during warm (cold) AMO phases. The similarities suggest that key components of AMOC are linked to basin wide temperature perturbations. Furthermore, our finding of a correlation between high medieval temperatures in Western Europe (800-850 AD) and a vigorous ISOW, as well as a correlation between low summer temperatures in Iceland and a markedly more sluggish ISOW (990-1050 AD), indicates that this coupling is representative for the past ∼2000 years and may have played a role in historically important climate perturbations.